Single-Flash Geothermal Power Plant Output and Utilisation

Separator steam fraction, turbine exhaust state by the Baumann rule, gross and electrical power, specific output and exergy utilisation of a single-flash plant.

Method: Single-flash cycle with Baumann wet-turbine rule and exergy utilisation

Input parameters

Unit system: SI

Parameter	Value	Unit
Reservoir temperature (saturated liquid)	250.00	°C
Separator temperature	160.00	°C
Condenser temperature	50.000	°C
Total geofluid flow	360,000	kg/h
Dry turbine efficiency	85.000	%
Generator efficiency	98.000	%
Dead-state (ambient) temperature	25.000	°C

Calculated results

Parameter	Value	Unit
Steam fraction after flashing	19.699	%
Steam flow to the turbine	70,918	kg/h
Turbine exhaust quality	87.124	%
Wet turbine efficiency	79.528	%
Turbine power	9.3145	MW
Electrical power	9.1282	MW
Electrical output per kg of geofluid	91.282	kJ/kg
Utilisation (exergy) efficiency	35.450	%
Condenser heat	40.881	MW

Notes for this case

• Isenthalpic flash to the separator; dry saturated steam to the turbine; Baumann rule η_tw = η_td(1 + x₅)/2 solved in closed form for the exhaust enthalpy. Utilisation efficiency is the electrical output over the exergy of the reservoir liquid relative to saturated liquid at T₀. Parasitic loads (pumps, fans, gas extraction) are not deducted. Water and steam properties from IAPWS-IF97.

Formula and method

$$x_2 = \frac{h_1 - h_f(T_{sep})}{h_{fg}(T_{sep})}, \quad h_5 = \frac{h_4 - A\left(1 - \frac{h_6}{h_7 - h_6}\right)}{1 + \frac{A}{h_7 - h_6}}, \quad A = \frac{\eta_{td}}{2}(h_4 - h_{5s}), \quad \eta_u = \frac{\dot{W}_e}{\dot{m} e_1}$$

Variables

T_{res}	Reservoir temperature (saturated liquid)	K
T_{sep}	Separator temperature	K
T_{cond}	Condenser temperature	K
$\dot{m}$	Total geofluid flow	kg/s
η_{td}	Dry turbine efficiency	-
η_g	Generator efficiency	-

T_0	Dead-state (ambient) temperature	K
x_2	Steam fraction after flashing	-
$\dot{m}_s$	Steam flow to the turbine	kg/s
x_5	Turbine exhaust quality	-
η_{tw}	Wet turbine efficiency	-
$\dot{W}_t$	Turbine power	W
$\dot{W}_e$	Electrical power	W
w	Electrical output per kg of geofluid	J/kg
η_u	Utilisation (exergy) efficiency	-
$\dot{Q}_c$	Condenser heat	W

Method and standards

Single-flash cycle.

Assumptions and limits

- Saturated-liquid reservoir; no non-condensable gases; no pressure losses in pipes.

References

Single-flash cycle with Baumann wet-turbine rule and exergy utilisation

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

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Reopens the calculator with the inputs of this report.